

Biological Evaluation of Ash at the Kenilworth Aquatic Gardens



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Abstract

On March 25-29, 2013 personnel from the USDA Forest Service, Northeastern Area, Forest Health Protection, Morgantown, WV. Field Office conducted a survey to detect emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) at Kenilworth Aquatic Gardens in the District of Columbia. The purpose of the survey was to survey for the presence of EAB and determine the need for treatment within the gardens. Since signs and symptoms consistent with EAB have been found in the natural areas within the park, it is recommend that a comprehensive forest management plan be developed and a chemical suppression/prevention treatment plan be put into place to protect high value ash (*Fraxinus* spp.) trees. The release of biological control agents is also recommended as a potential long-term control strategy of EAB. Although EAB is likely to have a profound impact on the garden the lack of management in controlling beaver activity, non-native invasive species and deer are having a far greater impact. This lack of active management calls into question the sustainability of forest stands at the gardens.

Purpose and Need

The Morgantown Field Office received a request for assistance with emerald ash borer (EAB) management from Biologist Mikaila Milton of the National Parks Service. She was recently informed that an adult emerald ash borer was trapped at Bald Eagle Hill Park which is located approximately 7 miles from Kenilworth Aquatic Gardens (KAG). The Morgantown Field Office addressed the request to investigate Kenilworth Aquatic Gardens for signs or symptoms of the emerald ash borer and identify any significant issues that might occur as a result of emerald ash borer in Kenilworth Aquatic Gardens.

Project Location Description

Kenilworth Aquatic Gardens is located along the Anacostia River on the eastern side of the District of Columbia and stretches into Prince George's County, Maryland (38°54' 45"N, - 76°56' 30"W). The garden covers approximately 297 acres, of which 114 acres are, forested (Figure 1). The aquatic gardens are a series of ponds where water lilies are propagated the same way the founder, W.B. Shaw, and his daughter, L. Helen Fowler, had done when the garden was started after the Civil War. The property became part of the National Park system in 1938. The main vegetation types include, Northern Atlantic Coastal Plain, Freshwater Tidal Marsh, Successional Upland Vegetation, Central Appalachian River Floodplain, Cultural / Cultivated Vegetation, Developed, Open Water, and Northern Atlantic Coastal Plain Tidal Swamp (Figure 2). The garden is comprised primarily of open water, marsh, floodplain, and urban land with approximately 27% of the garden open water.

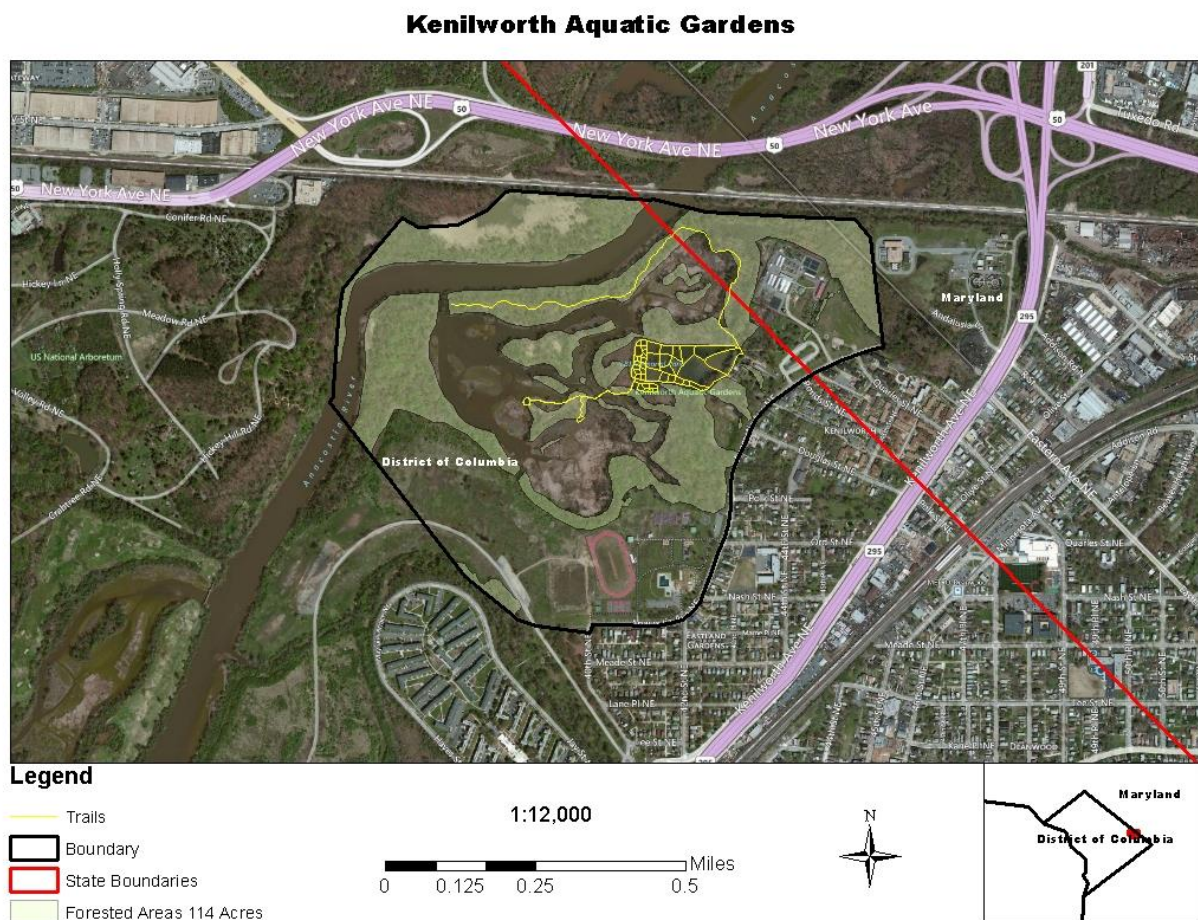


Figure 1. Kenilworth Aquatic Gardens, District of Columbia.

Project Objectives

The objectives for this evaluation were to 1) determine whether or not EAB was present within the garden, 2) determine the amount and condition of ash trees within the garden, and 3) determine the need for EAB management activities at the garden.

Project Methods

ARCMAP data

We used ARCMAP® data provide by U.S. Department of the Interior, National Park Service to identify the administrative boundary area, vegetation cover, and trail network. This data was then overlaid with National Agricultural Imagery Program (NAIP) data and Google earth imagery, which was used to digitize tree cover, calculate acreage, an establish a 100 foot wide trail buffer and select survey points.

Ash tree survey and inventory plots

To inventory and assess the ash population we established a 100 foot wide buffer on each side of all trails. All ash trees greater than four inches in diameter at breast height (dbh; 4.5 ft. above the ground; USDA 2001) within 100 feet of a trail were inventoried and assessed. For each tree we recorded species, crown class (i.e. dominant, co-dominant, intermediate, and overtopped; USDA 2001), presence of epicormic branching, insect sign, insect presence, presence of woodpecker activity, bark splitting, or loose bark, along with any signs or symptoms of disease, beaver damage, and the percentage of the bole girdled by beavers.

To assess ash populations in the areas outside the buffer, we used variable radius plots (10 basal area factor prism plots). Data was collected for all trees within the plot. For each tree we recorded species, status (alive or dead), dbh, beaver damage, and the percentage of the bole girdled by beavers. We also noted the presence of any non-native invasive species (NNIS), deer browse and amount of regeneration within the plots. Seventeen plots were established throughout the garden. Plot locations were randomly selected using ARCMAP (Figure 2).

Ash tree debarking

The garden was visually assessed, looking for signs of EAB. D-shaped exit holes were found on ash trees throughout the garden. A green ash, approximately five inches dbh, with extensive woodpecker activity was cut down and debarked to look for galleries of EAB.

Kenilworth Aquatic Gardens Inventory Layout

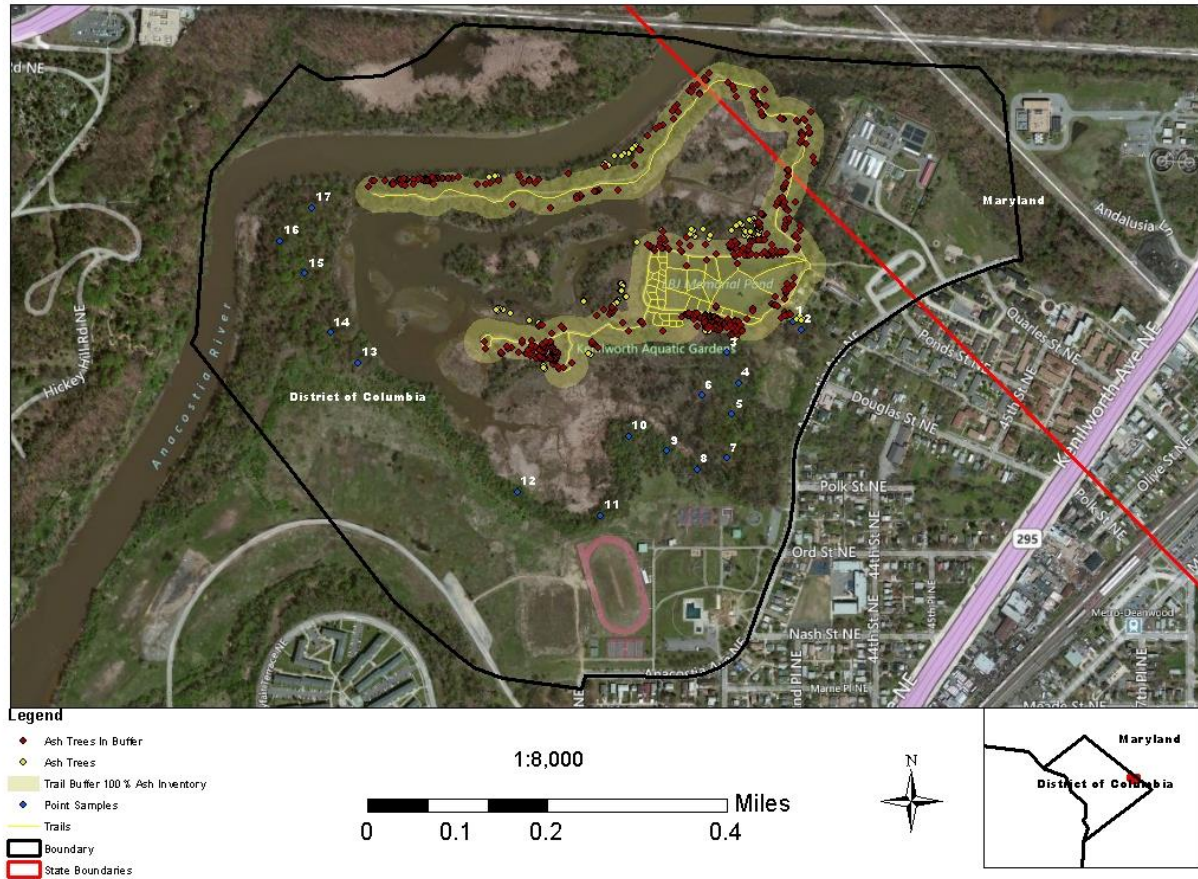


Figure 2. Survey map for Kenilworth Aquatic Gardens.

Results

Ash tree survey

The Aquatic Garden currently has three species of native ash, including pumpkin ash (*Fraxinus profunda*), white ash (*F. americana*), and green ash (*F. pennsylvanica*). Field surveys identified 504 ash trees within the trail buffer areas. Total basal area of ash within the buffer area is 11.8 ft²/acre with an ash stem density of 13.3 trees per acre. The median ash tree diameter is 10.5 inches with trees ranging in size from 1.0 to 36.0 inches dbh. Numerous hazard trees were observed in the buffer area around the trails.

Of the 504 ash trees assessed, 99 have epicormic sprouts, 59 have signs of insect attack on the bole, 68 had woodpecker activity noted, 11 had bark splitting, 8 had disease noted, 12 had loose bark, and 101 had beaver damage noted. Of the trees with beaver damage the average percent girdled was 47%.

Species Composition and basal area

Total basal area including living and standing dead trees was 83.5 ft²/acre with a stem density of 49.27 trees per acre. Ash species made up 19.01% of the total basal area per acre (Figure 3). With pumpkin ash making up 8.5%, green ash 6.3%, and white ash making up 4.2%. Other major components of the stand include red maple at 14.1%, black cherry 9.2%, pin oak 8.5%, sweet gum 7.8%, dead snags 7.0%, and yellow-poplar at 5.6%.

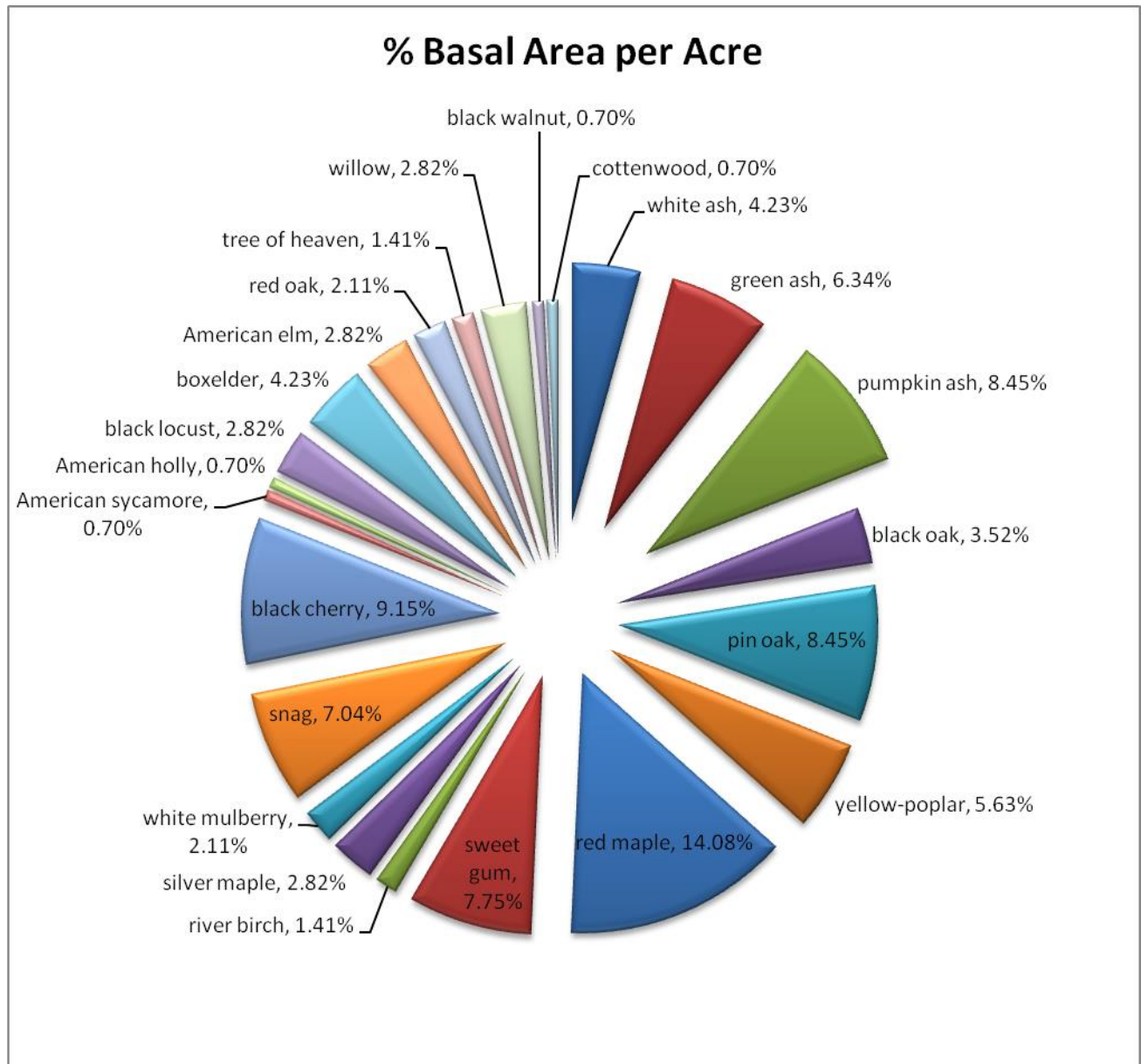


Figure 3. Percent of total basal area per acre by species for variable radius plots, Kenilworth Aquatic Gardens.

The median ash tree diameter is 14.1 inches with trees ranging in size from 1.0 to 33.8 inches dbh. Woodpecker activity was noted on a large percentage of tallied ash trees and D-shaped exit holes were found on one green ash. No beaver damage was found on any of the tallied trees outside the buffer; however a few willows were observed between the plots that were damaged by beavers.

There were copious amounts of non-native invasive species including English ivy (*Hedera helix*) and Japanese honey suckle (*Lonicera japonica*) both bush and vine varieties (Figure 4). There were also large patches of, buttercup (*Ranunculus sp.*) and tree of heaven (*Ailanthus altissima*) found throughout the inventoried areas.



Figure 4. Large areas with extensive English ivy and Japanese honey suckle infestation were observed in the wooded areas.

Japanese honey suckle appeared to be the most widely distributed as it appeared in 94.12% of the points sampled (Figure 5). English ivy was found in 64.71% of the points, buttercup was found in 35.29%, and tree of heaven was found in 11.76% of the points sampled. False holly, (*Osmanthus heterophyllus*) was also observed during the survey, along with extensive deer browsing and a lack of natural regeneration.

Ash debarking

The ash tree felled and debarked had eleven galleries consistent with EAB. Based on these results and the amount of woodpecker activity present on dead ash trees it is likely that EAB is present and active at the gardens.

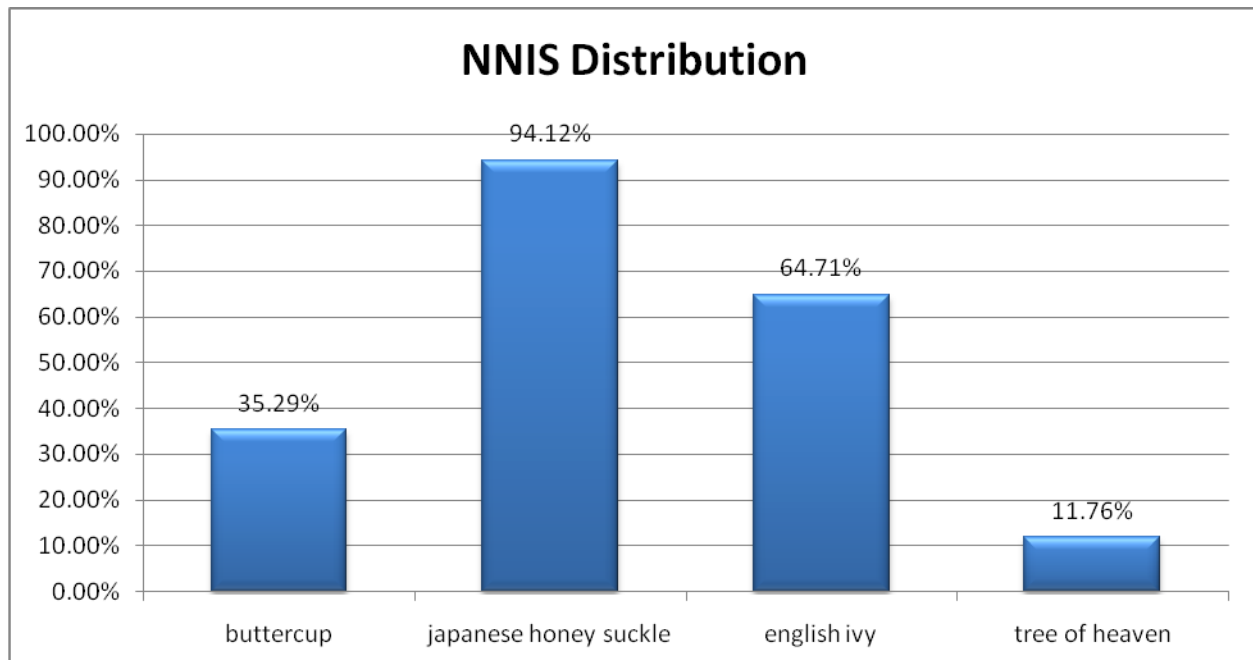


Figure 5. Percentage of survey plots with non-native invasive species, Kenilworth Aquatic Gardens.

Discussion

The main objectives of this evaluation were to determine whether EAB was present, inventory the area, and evaluate the need for EAB management activities. Although EAB has not been collected from the garden, the signs and symptoms present are consistent with EAB and the Park Service should proceed under the assumption that it is present and develop a comprehensive vegetation management plan for the gardens. This plan should include planting and timber stand improvement (TSI) activities that reduce the amount of greenbrier, poison ivy, and grapevine competing with the overstory trees. Vines should be removed from specific trees that are to be treated for EAB. These vines are, climbers, and creepers, which makes it nearly impossible for regeneration to become established and over time they out-compete overstory trees. The vines make overstory trees susceptible to wind and overtime the weight of the vines can pull them down or disfigure them. Grapevine is a valuable food source for wildlife, poison ivy berries are edible to birds, and greenbrier is good cover for wildlife, but if they dominate the stand they can decimate the ash trees, as well as the other trees in the garden. There is a pressing need to address the impact of NNIS species and deer browse at the garden. The NNIS present at the garden are having a negative impact on desirable vegetation by decreasing light availability, depleting soil moisture, nutrients, and inhibiting the regeneration of native plants.

A large amount of beaver activity observed at the garden (Figure 6). Beaver feeding can girdle trees and kill them it also creates an entry point for tree disease on surviving trees (Bullock and Arner 1985). These diseases (decay) decrease the longevity of the trees impacted by beaver feeding. As a result, all trees should be wrapped with fencing in order to protect them from the population of beavers that have already damaged a vast majority of the trees within the garden. This fence should be kept loose enough that it doesn't allow the tree to grow over it, but tight enough that the beavers can't get to the tree. Numerous hazard trees were also observed during this survey. Any trees that are not structurally sound or are dead on a trail edge should be removed.



Figure 6. Beaver damage at Kenilworth Aquatic Garden.

Although EAB is likely to have a profound impact on the garden the lack of management in controlling beaver activity, non-native invasive species and deer are having a significant impact as well. This lack of active management calls into question the sustainability of forest stands at the garden. It is recommended that the garden develop a comprehensive vegetation management plan that includes replanting and treatments to ensure a sustainable forest will continue at the garden.

Management Options

For 2013, three management options have been evaluated for managing EAB at the Kenilworth Aquatic Gardens. The intervention options are offered based on the following objectives: 1) protect high value ash trees; and 2) protect native woodland ash trees. Each option is discussed below.

No action option

In this option emerald ash borer is allowed to infest susceptible ash trees within the garden. Should this option be selected, it is likely that all susceptible ash trees would be attacked and die as a result of EAB. This would result in the loss of not only high value trees but native woodland trees which would result in hazard trees in public areas, and a reduction in overstory canopy and soft mast production in these areas.

Intervention Option

Chemical insecticide option

The second and third options are to use chemical insecticides to prevent and control EAB. Chemical control options for EAB were reviewed by (Herms et al., 2009) and include: noninvasive systematic basal trunk sprays, soil-applied systematic insecticides, trunk-injected

systematic insecticides, and protective cover sprays. Dinotefuran (Safari®) is labeled for controlling EAB and has shown variable results. It is sprayed on the lower 5 or 6 feet of trunk. Soil injection of imidacloprid has showed variable results and requires careful attention to soil conditions and tree dbh. Soil injections should be applied 2-4 in. below the soil surface to stay available to feeder roots, soil should be moist to facilitate uptake, and chemical amounts should be increased or combined with other treatment methods for trees larger than 15 in. diameter at breast height (dbh). Trunk injection of emamectin benzoate in mid-May or early June provides the most consistent control of EAB, according to test trials at Michigan State and Ohio State Universities. This was the only treatment that provided multiple years of protection (up to three years). Protective cover sprays have been shown to prevent EAB from entering trees in Michigan State University studies, but have no effect on larvae feeding under the bark. Spraying the entire tree is most effective, but there is considerable drift associated with this process. A natural product azadirachtin is also available formulated as TreeAzin™ which has the potential for systemic control of EAB. This product is natural tetranortriterpenoid compound extracted from the seed kernels of the neem, (*Azadirachta indica*)(McKenzie et al., 2010) and is trunk injected into the tree.

Biological control

Currently, three parasitoid wasps, including two gregarious larval endoparasitoid species, *Spathius agrili* and *Tetrastichus planipennisi* and a solitary parthenogenic egg parasitoid, *Oobius agrili* are available for release against EAB. The release and establishment of EAB natural enemies is not likely to provide any short term control of EAB. This long-term approach is still experimental and will likely require a complex of natural enemies to maintain EAB below damaging levels. It may be years before these parasites can self-perpetuate sufficiently before any level of success can be determined.

Alternatives

- | | |
|----------------|---|
| Alternative 1. | No action |
| Alternative 2. | Treat all garden and woodland ash trees. |
| Alternative 3. | Limits treatments to all cultivated garden trees and the treatment of buffer zone ash trees > 15 inches diameter at breast height and the release of biological control agents. |

Recommendations

Because EAB is already at infestation level at Kenilworth s it is recommended that that a comprehensive ash/forest management plan be developed and a chemical suppression/prevention treatment plan be put into place as soon as possible. In addition it is recommended that a public awareness campaign, be instituted about emerald ash borer.

Alternative three is recommend based on the following considerations.

- 1) Based on high numbers of EAB at the Kenilworth Aquatic Gardens.
- 2) This alterative protects the high value cultivated garden ash and retains large specimen trees in remnant wetlands and woodland areas.
- 3) Release and establishment of available EAB parasitoids is also recommended in infested areas on ash that are not in close proximity to chemical treatments. The establishment of these natural enemies offers the opportunity for long-term control and may minimize the need for repeated chemical treatments in future years.

Species Evaluation

Emerald Ash Borer (EAB) *Agrilus planipennis* (Fairmaire) is a wood-boring beetle from eastern Asia (Poland and McCullough, 2006) that is causing severe mortality in North American ash (Tluczek et al., 2011). EAB affects all species and diameter classes of ash and often kills both healthy and stressed trees within three to five years after becoming infested (Siegert et al., 2006). Based on the data from USDA Animal and Plant Health Inspection Service (APHIS), EAB emerge around mid-June and are present through mid-August (www.emeraldashborer.info). Adult beetles are slender, elongate, and bright green and feed on ash foliage in patches along the leaf margins (Kovacs et al., 2010). Adult beetles usually live for about three weeks and females lay about 60-90 eggs (McCullough and Katovich, 2004). Eggs hatch in 7-10 days and larvae chew through the bark and feed on phloem and outer sapwood for several weeks, creating S-shaped galleries packed with frass (Bauer et al., 2004). Larvae are white to cream-colored, 10-segmented, and flattened. Larvae overwinter in shallow chambers in the outer sapwood or bark on thick-barked trees(Bauer et al., 2004). EAB pupate in late April or May and adults emerge 1-2 weeks after pupation through D-shaped exit holes (McCullough and Katovich, 2004).

In addition to causing severe economic damage, there are ecological consequences associated with the loss of ash from North American forests. Studies show that ash provides food and habitat for several bird and mammal species (Faanes, 1984; Rumble and Gobeille, 1998). Forty-three native arthropod species are at high risk due to their association with ash for breeding or feeding (Gandhi et al., 2010). In addition, ash contributes to nutrient cycling in hardwood forests (Reiners and Reiners, 1970).

Additional Sources

TSI

<http://nrs.fs.fed.us/fmg/nfmg/docs/mn/TSI.pdf>

<http://www.forest-management.com/Timber%20Stand%20Improvement.htm>

<http://www.kansasforests.org/pubs/riparian/Timber%20Stand%20Improvement.pdf>

Beaver Fencing

http://www.beaversolutions.com/tree_protection.asp

Hazard Trees

http://na.fs.fed.us/fhp/hazard_tree/pubs.shtm

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